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THE EXPLOSIVES ENGINEER

Forerunner of Progress in Mining, Quarrying, Construction

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Trade demands make it necessary for Dulin Bauxite Company to recover three types of ore, each with a different chemical analysis, from widely scattered working places in their Nutt Bailey mine at Sweet Home, Arkansas. The shifting of operations precludes permanent equipment installations.

Economical transportation in the poorly ventilated mine, 270 ft. underground, was a major problem. A description of experiments with the use of jeeps underground, and the methods employed by the company in drilling and blasting the variable ore, is presented in an article by C. Thorsten Brandt, beginning on page 7.

Drilling, blasting, and disposing of banks of slate and shale overburden, 40 ft. to 60 ft. high, in high, mountainous country in Virginia and West Virginia, form the basis of an article by R. H. Counts, beginning on page 24.

In a report on the oil-shale mine demonstration at Rifle, Colorado, by the U. S. Bureau of Mines, in the latter part of September, Professor Philip B. Bucky writes that the production rate is over 90 tons a man-day for all workers and supervisors connected with the operation. Also, the total mining cost is estimated at less than 50 cents and the direct mining cost at under 33 cents a ton, with labor at $1.50 an hour. Please turn to page 12.

How coal was mined on a panel system, at working places three miles underground, is described on page 16, by John A. Fulmer, assistant superintendent, New Castle Coal Company, New Castle, Alabama.

EDITORIAL STAFF: Joseph I. Hoffe, *Managing Editor*; Elizabeth M. Dyer, *Assistant Editor*; Edward L. Grant, *Art Editor*; Frank J. Cavins, *Production Manager*; C. E. Rabenold, *Advertising Manager*; Theodore Mayer, *Director*; M. R. Bull, *Associate Director*.

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The mine was opened in 1892, using a single-entry, room-and-pillar system, and mule transportation. The company introduced electrification in the mine in 1923, adopted improved operating methods and equipment as they became available, and, during the past ten years, developed and maintained an average production of 1,100 tons of coal a day. Operations were discontinued in July of last year because of the unsettled conditions in the industry.

The award of a contract to construct a tailrace in the Connecticut river marked the first operating phase in a $5,000,000 expansion program of Holyoke Water Power Company, Holyoke, Massachusetts, leading to the full development of the water facilities at the Holyoke Dam. On page 20, E. F. Perreault tells about some of the operating details involved in the project, as carried on by the contractor, D. D. O'Connell's Sons, Inc.

Erratum: In the article, "Mining 6-Ft. Coal Seams Near Wolf Summit, West Virginia," published in the November-December, 1949, issue of The Explosives Engineer, we referred to the spacings of holes drilled into the coal seams as on 7-in. centers. This was in error. The spacings should have been referred to as on about 7-ft. centers.

We regret that this inaccuracy was not detected before the article was printed.

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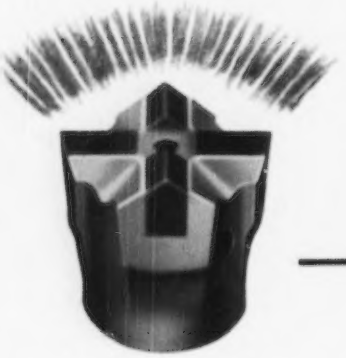

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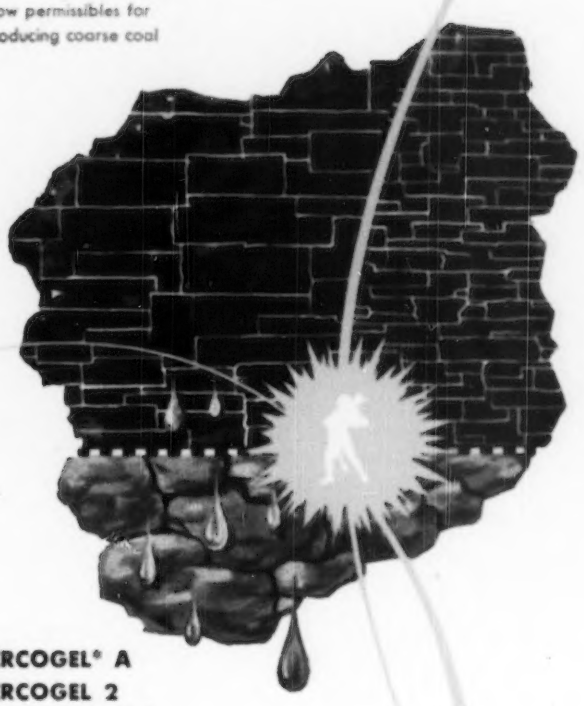

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Arthur Hugh Bunker

PRESIDENT, CLIMAX MOLYBDENUM COMPANY

A Biography

ARTHUR HUGH BUNKER, president of Climax Molybdenum Company, is a general executive, rather than a production man, who leans heavily on the technical members of his staff, at the same time maintaining close contact with everything that goes on within the organization. He is one of those rare individuals who thrive on long hours, handling an enormous volume of work without showing strain.

Arthur, as he is known to his friends and associates, was born in Yonkers, Westchester County, New York, July 29, 1895, the son of George Raymond and Jeanie Polhemus (Cobb) Bunker. His father, founder and president of National Sugar Refining Company, was associated throughout his career with various activities in the sugar business in Cuba, Puerto Rico, and the United States. His mother came from a family long and prominently identified with the Dutch Reformed Church, as clergymen and missionaries.

Bunker prepared for college at Taft School, Waterbury, Connecticut, where he played football, golf, and tennis, and was on the track team as a hammer thrower and a shot-putter. In 1913, he went to Yale University, majoring in electrical engineering in Sheffield Scientific School. He played freshman football and, subsequently, was made manager of the varsity track team. He was graduated in 1916. After completing his studies at Yale, he took a one-year postgraduate course in thermodynamics at Armour Institute, Chicago.

Arthur Bunker's first job was with American Ice Company, electrifying plants in New York City. With our entrance into World War I, he joined the U. S. Naval Reserve as an engineer-officer in aviation, with the rank of lieutenant. When the war was over, he went to Colorado and became president of Radium Company of Colorado, serving from 1921 to 1925. In 1922, hearing that radium had been discovered in the Belgian Congo during the war years, he went to Brussels and found the Belgians ready to proceed with the manufacture and distribution of radium. He formed a joint Belgian-American Company, brought Belgian engineers to Colorado for training, and sent American engineers to Oolen to design and build a plant in Belgium.

In 1925, Arthur Bunker organized United States Vanadium Company, was made its president, and proceeded with the development of properties at Rifle, Colorado. In 1927, the company was sold to Electro Metallurgical Company, a subsidiary of Union Carbide and Carbon Company. The ore dumps, resulting from the extraction of vanadium, contained large amounts of uranium which was recovered during World War II.

Following the sale of U. S. Vanadium to Union Carbide, Mr. Bunker took over the presidency of Carib Syndicate, Ltd., and Colon Oil Corporation. These companies owned undeveloped oil properties in the Maracaibo Basin area of Venezuela and Colon, on the Venezuelan boundary.

In 1928, Bunker obtained an option on the Thomas Young Nurseries, Bound Brook, New Jersey. He succeeded in turning a disorganized business into an efficient producing and distributing unit. Before he disposed of his interest, it became big business. Today, more orchids bloom at the Thomas Young Nurseries than in any other spot on earth.

In 1929, Mr. Bunker became executive vice president of The Lehman Corporation, an investment trust formed at the time. In addition to acquiring investments in listed securities, this company was identified with various mineral interests, purchased and operated Simms Oil Company, engaged in the recycling of gas in the Corpus Christi, Texas, area in the early days of its development. It was prominent in the development of Potash Company of America and was identified with Canadian mining through Anglo-Huronian, Ltd.

In 1941, Arthur Bunker resigned from The Lehman Corporation to join the War Production Board in Washington, D. C., as director of the Aluminum and Magnesium Division. Under his direction, the production of aluminum was expanded 700 per cent and magnesium production was increased 10,000 per cent. In logical succession, he was made vice chairman for Metals and Minerals and later Chief of Staff of the WPB.

At war's end, Bunker became a general partner of Lehman Brothers, from which firm he resigned on June 30, 1949, to become president of Climax Molybdenum Company, of which company he had been a director since February, 1949. His other business associations include directorships in American Metal Company, Ltd., Firth Sterling Steel & Carbide Corporation, The Lehman Corporation, and The Commercial National Bank & Trust Company of New York.

Arthur Hugh Bunker married Antoinette Marie Blache in New York City, May 9, 1933. They have three children, Adele Bunker Hynes, George Raymond Bunker, and Daphne Joan Bunker. The family home is at 208 East 52nd Street, New York 21, New York.

His clubs include Yale, Knickerbocker, River, Cloud, and Lunch, in New York; Metropolitan, in Washington; Duquesne, in Pittsburgh; and Denver, in Denver.

In 1933, Mr. Bunker bought a large farm in New Hampshire and promptly set about developing it into an active self-sustaining project. Today, the dairy end of the business includes 150 pure-bred Jerseys, and the poultry enterprise involves 10,000 chickens. Its successful operation has become his hobby, an ideal means of finding relaxation from the demands of his diversified business interests.

ARTHUR HUGH BUNKER

Editorial

Big Year Ahead for Construction

A study of private and government estimates by The Associated General Contractors of America, which represents more than 5,500 leading construction companies throughout the United States, indicates that it is possible for the industry to put in place in 1950 more than $20,000,000,000 worth of new construction and approximately $9,000,000,000 worth in maintenance and repairs. These figures include rough estimates for some types of construction not included in official government estimates, such as the vast program of the Atomic Energy Commission.

The AGC emphasizes that the above estimate represents possibilities for the construction industry in 1950, rather than a forecast that the volume would be attained. Continued favorable business conditions, price stabilization, and sustained general optimism for the future by prospective purchasers of construction would be required for the realization of this estimate.

Last year's volume of $28,500,000,000 represented roughly 11 per cent of the gross national production of goods and services. Since the war, the construction industry has been advancing steadily toward the position it occupied in the prewar economy. In 1945, construction was 4.5 per cent; in 1946, 7.7 per cent; in 1947, 9.2 per cent, and in 1948, 10.2 per cent of the total national product. Construction is assuming once more a powerful stabilizing influence in the national economy.

Increased production means increased consumption of industrial explosives. The explosives industry is prepared to meet promptly any demands that may be placed upon it.

Aids for Better Blasting Results in Underground Work

Avoid the use of explosives which have obviously deteriorated.

Use the largest diameter cartridge of explosives which is consistent with the work to be done—preferably not less than 1⅛ in. in diameter.

Explosives should be loaded into drill holes in the wrappers supplied. Do not remove wrappers from an explosive or add paper or other combustible material to the charge.

Do not overcharge. Explosives used in excess of needs cause increased proportions of poisonous gases.

Avoid all conditions which may cause burning rather than detonation of the explosives, such as breaks in the explosives column and the separation of the primer from the remainder of the charge.

Confine the explosives charge properly with noncombustible stemming, preferably moist sand or clay, or other suitable stemming material.

In wet work use an explosive having adequate water resistance and fire the blast as soon after loading as practicable.

Provide adequate ventilation—make sure that the air is directed to the working places.

National Conventions—1950

Producers of commercial crushed stone and representatives of manufacturers of equipment and supplies from all sections of the country met in Chicago, Illinois, January 30 through February 1, 1950, at Hotel Stevens, to attend the 33rd annual convention of the National Crushed Stone Association. Immediately following, members of the Agricultural Limestone Institute held a three-day meeting, its 5th annual convention. The programs included group meetings for thorough discussions of operating problems, and the interchange of factual data of special interest to the crushed stone industry. An exposition of mechanical equipment and supplies by nationally prominent manufacturers provided added interest to the convention.

Approximately 3,000 members and guests attended the 1950 Annual Meeting of the American Institute of Mining and Metallurgical Engineers, in New York City's Hotel Statler, February 12 through 16—the 170th general convention of A.I.M.E. A new high was attained in the variety of technical papers presented, and in the number of sessions and group forums for the discussion of subjects relating to production, preparation, and properties of minerals, metals, and fuels.

The 1950 Annual Coal Convention of the American Mining Congress will be held in Cincinnati, Ohio, April 24 through 26, with headquarters in the Netherland Plaza Hotel. The national program chairman, E. R. Price, manager of coal properties of Inland Steel Company, and his committee of 44 well-known operators and equipment manufacturers, has arranged a comprehensive program that will reflect the spirit of progress in the industry.

The number of advance reservations has already given evidence of the wide interest in the coming coal convention, throughout the industry.

Nutt Bailey Bauxite Mine IN ARKANSAS

Photographs, courtesy U. S. Bureau of Mines

Jeeps used successfully for haulage in a poorly ventilated underground mine.

C. THORSTEN BRANDT*

AN INTERESTING and so far successful experiment in the use of jeeps in a poorly ventilated underground mine is now being carried on in the Nutt Bailey mine of the Dulin Bauxite Company, Sweet Home, Arkansas. The experiment has been under way for about five months. If present results are any criteria, the improvements in underground mining procedure and benefits to be derived therefrom in bauxite mining are endless.

The experiment, motivated by a multitude of factors not uncommon to many mining operations, normally would die a quick death on suggestion. It was strongly condemned prior to its inception. However, to clarify the reasons for the attempt to use jeeps in the Nutt Bailey mine, a short explanation as to the operations of an independent company in the bauxite-mining industry is necessary.

The Dulin Bauxite Company is the only independent organization now engaged in actual mining operations in the Arkansas bauxite field. The mining of bauxite is carried on in the remainder and by far the larger part of the field by either Alcoa Mining Company or Reynolds Mining Company. Both Alcoa and Reynolds have a limited market for the metal-grade ore that they produce in this area. Further, these two companies are the only purchasers of any metal-grade ore that may be produced in the area. The two remaining outlets for bauxite, the abrasive and the chemical markets, require only small amounts of ore. Under these conditions, the market for ore produced by the Dulin Company is definitely limited.

Since the three types of bauxite required for these consumers are of different chemical analyses and there is no beneficiation process which will render one type of ore suitable for any particular market, it is necessary to mine and ship the grade of ore as needed. This requirement has imposed obstacles which are not common to most mines and which do not lend themselves to planned mining, a fact that affects not only recovery but costs.

In the usual bauxite mine where only one type of ore is desired, the normal procedure for following a development

*Consulting Mining Engineer,
C. T. Brandt & Co., Engineers,
Little Rock, Arkansas.

plan can be achieved and the ore can be taken as one comes to it. However, where an operator has to produce according to demand, it is frequently necessary to alter plans to fit market requirements. This shifting of operations does not lend itself to permanent equipment installations. Also, the geologic characteristics of the Arkansas bauxite deposits do not make desirable the use of present-day mobile-haulage equipment.

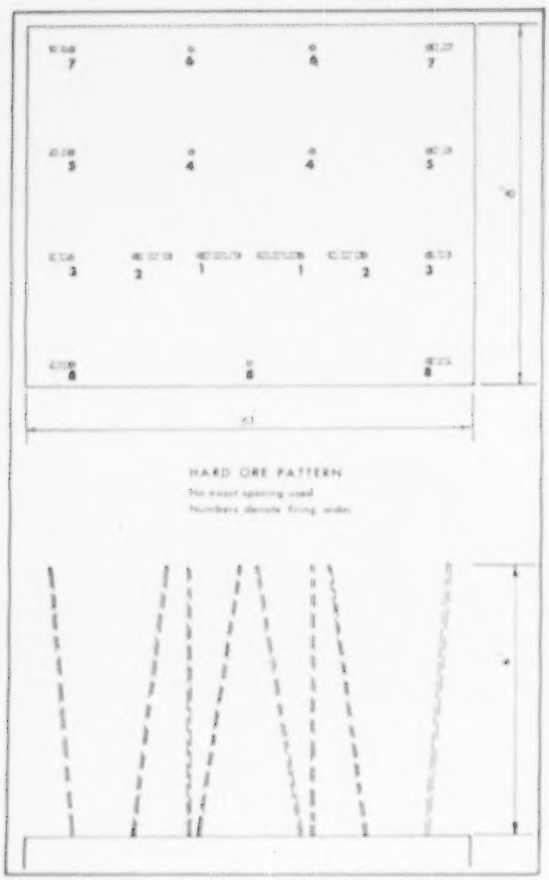
The Nutt Bailey mine is fortunate in having all three types of bauxite available but they are widely scattered throughout the mine. Briefly, this particular deposit contains approximately 200,000 tons of bauxite, lenticular in shape, with a general pitch of approximately seven degrees. It lies at a depth of 270 ft. and is reached by a 76-in. single-compartment shaft. The thickness of the ore body varies from 7 ft., considered to be the minimum mineable thickness, to 30 ft., and is underlain by clay. The roof consists of clay and lignite. Small openings can be driven through the bauxite with safety, but large openings will not stand well. Because of the physical characteristics of bauxite, timbering is usually of small value. There are exceptions, of course, but usually it is necessary to timber tightly, the cost of which is so high that it rules out the timbering of anything but a main haulageway.

Drilling the Ore

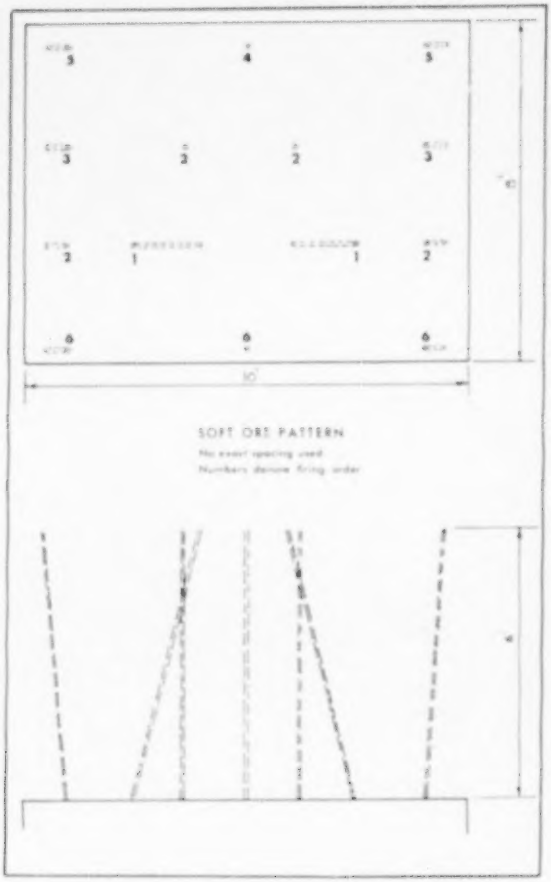
Since the bauxite is an easily drilled ore, three crews of drillers, each consisting of two men operating a 40-lb. Ingersoll-Rand RB-12 Jackhamer, do all of the drilling. Wet drilling, using ⅞-in. hollow hexagonal steel and 1⅜-in. detachable bits, gives a drilling speed which varies from 1½ ft. to 3 ft. a minute. Air for the drills is supplied by two Ingersoll-Rand Model 75M compressors, located on the surface.

Two types of drill patterns are used, depending on the hardness of the ore. In soft ore, a 14-hole pattern is used and the drill holes are loaded with four or five cartridges of dynamite. In hard ore, an 18-hole pattern is used and each drill hole is loaded with six cartridges of dynamite. Hercomite* 3, in 1⅛-in. by 8-in. cartridges, is the dynamite used. No stemming is employed to

*Reg. U. S. Pat. Off.



DRILL ROUND, HARD ORE. Approximately 17 holes are drilled in a typical round in the hard-ore working faces. Order of firing a blast is indicated by the numbers near the drill holes.



DRILL ROUND, SOFT ORE. Location of 14 drill holes in a representative round. Spacings vary in accordance with physical conditions at working faces. The numbers indicate the order of firing.

tamp the dynamite charges. Blasts are fired by means of blasting caps and safety fuse. Diagrams of the two types of drill rounds are illustrated on page eight.

In soft ore, from 25 to 30 long tons are broken in each round. The harder ore yields 10 to 15 long tons per round. Broken down, these figures represent a ratio of 2,075 lbs. of ore per pound of dynamite in soft ore and 820 lbs. of ore per pound of dynamite in the hard ore.

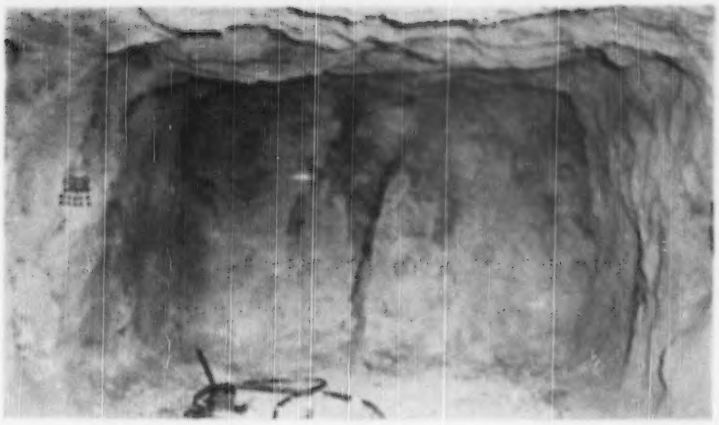
At present, two types of loading are in use at this mine. In the older method, two muckers hand-muck the ore in 22-cu. ft. cars which are hand-trammed to the shaft by a third man. These three men can clean a face of approximately 30 tons in six hours. In the newer method, an 8-BU Joy loader loads into two modified jeeps, each carrying a 36.5-cu. ft. bed. In this latter operation, a loader operator and two jeep drivers are employed, and the face can be cleaned in approximately one to one and a half hours.

The ore is hoisted to the surface in a 50-cu. ft. skip and dumped into a small stock pile, from which it is loaded into trucks by means of a ¾-cu. yd. Lorain Diesel shovel for transportation to either the shipping or milling point.

Mining Methods

The normal method of mining this ore body would be to drive a small haulage drift either up or down the slope, and drive parallel stopes off this haulageway along the bottom contours of the ore body. These stopes would be driven to the extremities of the ore body and then the caving process would be started. During development, care is taken to leave at least 2 ft. of bauxite in the roof to prevent dry-slacking of the clay and lignite. Following development, the ore body is caved by cutting pillars, removing as much ore as is safely possible and then allowing the roof to cave.

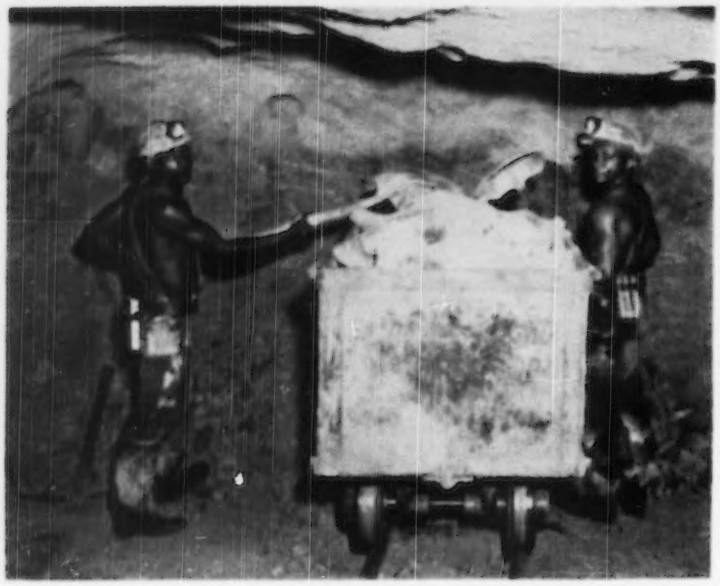
In several of the larger mines, Joy loaders and shuttle cars are being used with varying degrees of success. It has been necessary to lay timber floors over the clay in order to prevent shuttle cars from getting stuck. Further, it is necessary to provide passing spaces for shuttle cars at rather frequent in-



IN A DRIFT: A working face in a drift, ready to be drilled and blasted.

AFTER A BLAST: Blasts in the harder ore average 10 to 15 long tons; in the softer ore the yield is from 25 to 30 long tons.

LEFT TO RIGHT: W. B. Olsen, mine superintendent, and Mr. Allen, U. S. Bureau of Mines engineer, examining the results from a blast.



LOADING ORE. Miners hand-mucking blasted ore into a 22-cu. ft. hand-trammed car.

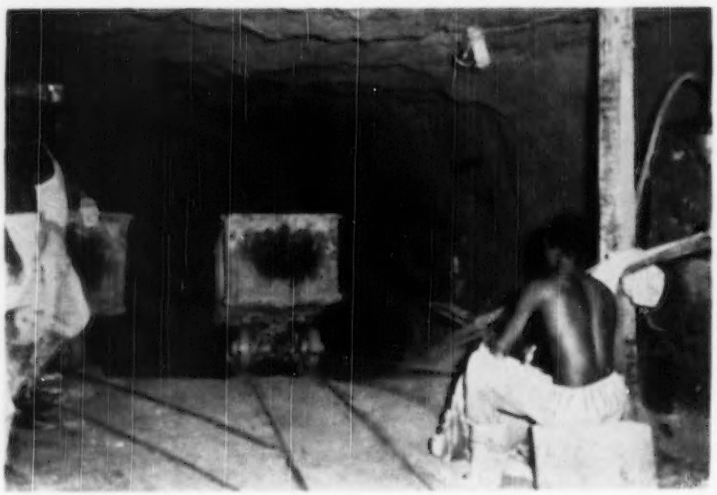
tervals. Also, it developed that loaded shuttle cars will not operate satisfactorily on a grade of over 4 per cent.

The procedures outlined are not feasible in the Nutt Bailey mine because of the daily variation of ore requirements. The constant shifting from one working place to another would necessitate flooring the entire mine and the cutting of many passing places for shuttle cars. Therefore, the Dulin Company conducted its operations in a small way, using 22-cu. ft. end-dump cars on 12-lb. and 16-lb. rail. Hand loading and hand tramming were used entirely, the muckers being paid so much a car. This system was economical as long as the mine remained small and the muckers did their own tramming. As the mine developed, it became necessary to add trammers. Tramming costs rose until they reached 60 cents a ton. It was quite evident that something drastic would have to be done.

Experiments with Jeeps Underground

It was rumored that internal combustion engines were being used in an underground mine in Missouri. Investigation developed that this practice was being followed successfully in a well-ventilated lead-zinc mine with some modifications, namely, the addition of oxygen to the exhaust discharges. It was decided to give this practice a try. A jeep was modified in accordance with those used in the lead-zinc mine and lowered down the shaft. It was tested for a month, both in the standard and modified form, for its noxious gases, pulling ability, adaptability, and effect on an untimbered floor. After four weeks of experimenting, it was decided to abandon the modifications and use a standard jeep and trailer. Accordingly, a 45-cu. ft.-capacity trailer with a fifth wheel was constructed. This rig was tested for the factors outlined. It was found that a 2-ton load operating over untimbered floors was practical; also, that the jeep fully loaded would operate without difficulty over any grades encountered, but that considerable trouble was experienced in maneuvering backwards because of the short turning radius. Consequently, the trailer body was modified, the fifth wheel was removed, and the trailer securely fastened to both members of the frame so as to allow vertical movement only.

This jeep-and-trailer combination was thoroughly tested for noxious gases and, with the exception of one or two places, only a trace was indicated. Therefore, the idea was considered to be practical, and two more jeeps and trailers were purchased along with a Joy 8-BU loader. These are now in operation in the mine. It has been found that the three jeeps, operating at a distance of approximately 1,100 ft. from the shaft, can handle the output of the loader adequately. No trouble has been encountered in the floor and no wide passing or turn-around places have been required. Using two jeeps in current operations, approximately eight minutes is required for a complete round trip, including loading and unloading. Three men now produce as much as twelve men produced before.



EN ROUTE. One of the mine cars being pulled up an incline by means of an air hoist.

Ventilation

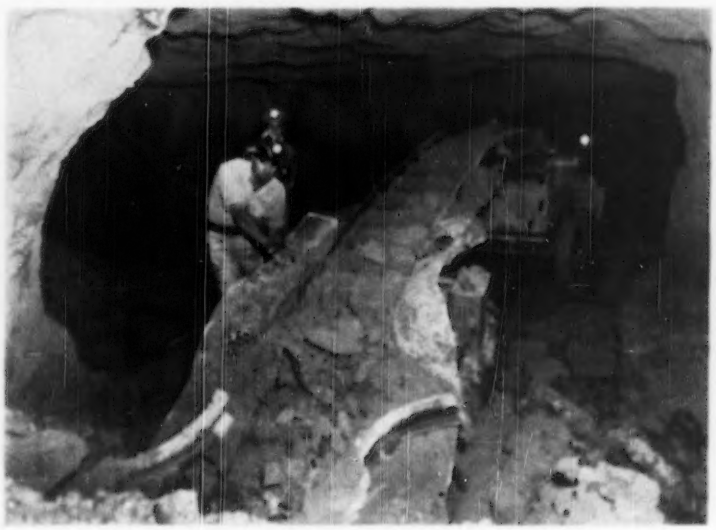
As stated, no trouble has been encountered in the removal of fumes. This is difficult to understand completely and is logically inexplicable when it is considered that this ore body lies at a depth of 270 ft. and is reached by only one round, steel-lined, single-compartment shaft. Ventilation and circulation are supplied by five fans located on the surface, connected with the mine through 6-in. cased holes. These holes are not spaced at any regular intervals nor is the output from the hole piped to the working face. Three fans act as exhaust fans and two as blowers. Tests with a velometer show that the three exhaust fans are moving about 1,870 cu. ft. a minute; the two blowing fans are supplying an estimated 1,275 cu. ft. a minute. The remainder of the air is supplied from the shaft and from pipe leakage. The total volume of the mine may be roughly calculated to be 2,300,000 cu. ft. which means that, theoretically, a complete air change takes place every 20.4 hours.

This would seem totally inadequate to maintain a good working atmosphere. Some of us were not satisfied with the results obtained as to the amount of carbon monoxide present as shown by the type of indicator being used (iodine pentoxide). Therefore, a different type of indicator (M.S.A. Carbon Monoxide Indicator) was obtained from the State Health Department and a check was made with it. The results of these two indicators were synonymous. With one or two exceptions, it was found that after six or eight hours of operation, only a trace (– 0.01%) of carbon monoxide was found. In those places where dangerous amounts of CO were found, the per cent was the same at both the working face and the shaft, and was apparent after about one-half hour of operation. The fumes would dissipate within 15 minutes after a cessation of operation.

To further reduce the amount of carbon monoxide given off by the jeeps, a conversion was made so that the engines would run on butane. The conversion was achieved successfully by the utilization of small portable tanks which are charged on the surface and taken underground for use. The percentage of carbon monoxide in the air was reduced considerably but the odor of other fumes from the butane was more noticeable. If anything, more power was obtained from the jeep through this change. Because of the increase in explosive hazards in the mine, extreme safety measures have been invoked and are in effect.

It is anticipated that the use of flexible tubing to conduct air to those working faces where concentrations of noxious gases are evident will remove any dangers caused by fumes.

ALL SET: A modified jeep is driven under a Joy loader at one of the mine headings.



MECHANICAL LOADING: Joy loader excavating and loading blasted ore into a jeep.

Difficulties to Overcome

Currently, three difficulties are most prominent. One is the power drop between the transformer and the loader, causing occasional difficulty in loading. This has been remedied by stepping up the available power and moving the transformer nearer to the loader. Experience has shown that a loader will not work well more than 500 ft. from the transformer.

The second, and by far the greatest difficulty encountered, lies in keeping the mucking machine in ore. Since the mine is still in the final stages of development, no caving is taking place and no large muck piles are available. Further, the muck piles at the face are smaller than usual because of the necessity of driving through thin ore which results in smaller sized drifts. Breakage is now only 20 to 25 tons a

(Continued on page 28)

COLORADO OIL SHALE MINE DEMONSTRATION

Results give evidence that the production rate per man-day in underground mining can be increased.

PHILIP B. BUCKY*
Consulting Mining Engineer

MINING men will find it difficult to believe that there is an experimental underground mine operating on a full-scale unit basis at Rifle, Colorado, where the production rate is over 90 tons a man-day for all workers and supervisors connected with the operation. The total mining cost at this plant is estimated at under 50 cents and the direct mining cost at under 33 cents a ton, with labor at $1.50 an hour.

When compared with the average production rate in U. S. bituminous-coal mines of 5.4 tons a man-day with a high approaching 10, and with the best U. S. underground block-caving practice of 32 tons a man-day, the importance of examining the results of this experiment seriously may be more fully appreciated.

The U. S. Bureau of Mines' oil-shale program was authorized by the Synthetic Liquid Fuels Act of 1944. The reason for the passage of the act was a desire on the part of Congress to ensure our independence of outside countries as a source of liquid fuels. An Oil-Shale Demonstration Plant was erected on the U. S. Naval Reserve at Rifle, Colorado, and was dedicated and placed in operation in May, 1949.

Since the founding of the oil industry with the sinking of the Drake well in Pennsylvania in 1859, the demand for liquid fuel has so increased that we are finding it desirable to consider the treatment of solids to augment the supply. At present, the top of the growth curve of demand for liquid fuels appears to be considerably in the future.

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What Is Oil Shale?

The oil shale being mined in the Green River formation at Rifle, Colorado, is not a shale and does not contain oil as such. It is a magnesium marlstone containing a solid carbonaceous material called kerogen. Kerogen consists mainly of organic matter such as algae, pollen, spores, and insects.

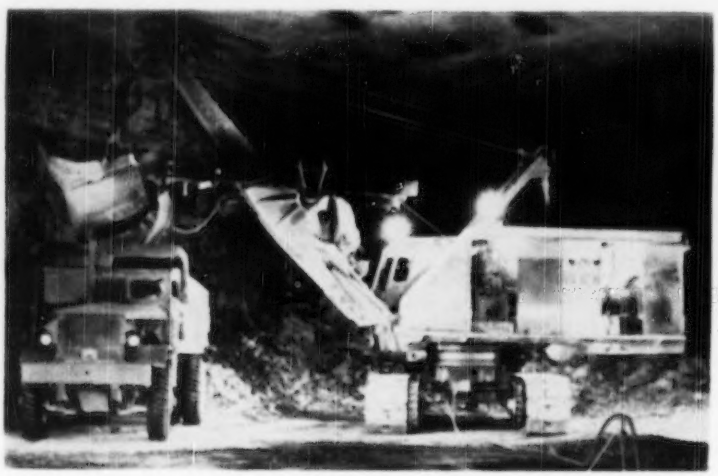
The formation is a fine-grained sedimentary rock of laminar structure. It has considerable structural strength and varies in color from gray to almost black. When heated to 800 degrees Fahrenheit, the kerogen is converted to shale oil, which can then be further refined. Heat for the process is available from gases produced in the retorting operation and from the fixed carbon remaining in the shale after retorting.

Mining the Top Lift

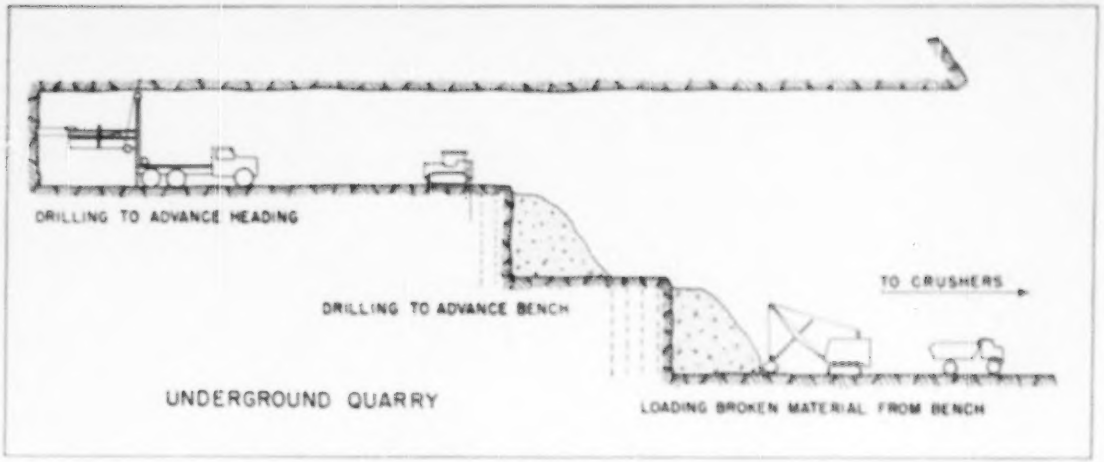
1.	Dimensions of opening worked: 27 ft. high, 60 ft. wide; any length	
2.	Artificial support required	none
3.	Number of men, underground crew	13
4.	Supervisors and maintenance men, underground	3
5.	Number of men charged to mining	16
6.	Footage drilled per man-shift	540
7.	Dynamite used, semigelatin grade	470
8.	Tonnage broken per lb. dynamite, top level	2.2
9.	Tons mined per shift, top level	1491
10.	Tonnage production per man-day	92.7
11.	Tonnage production per miner	115.7

The principal equipment used in the mine includes a jumbo, mounting 4 drills, single steel; a mechanized portable blasting platform; a portable compressor and utility unit; a mechanized portable scaling rig; a 3-cu. yd. Bucyrus-Erie electric shovel; a caterpillar bulldozer; and three 15-ton Euclid rear-dump trucks.

Visitors attending the demonstration at the mine September 7 to October 4, 1949, were impressed by the



UNDERGROUND SHOVEL. Deep within the mine, this 3-cu. yd. electric unit loads oil shale into 15-ton Diesel trucks.

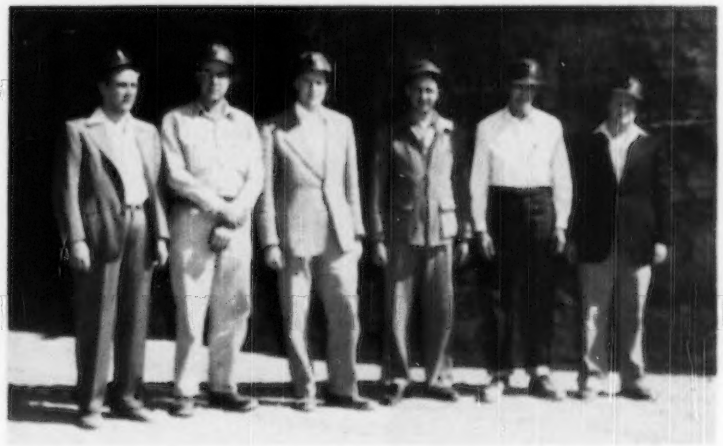


UNDERGROUND QUARRY. The top level is being worked at present, in openings 27 ft. high by 60 ft. wide, followed by two benches 21½ ft. high.

large dimensions of the rooms and pillars; the 3-cu. yd. underground shovel; the 15-ton Diesel trucks; the drilling, compressed air, and scaling equipment; and the scientific apparatus for taking roof measurements and determining the physical properties of the geologic material. Descriptions of the equipment, with illustrations, were presented in the article, "Mining Oil Shale at Rifle, Colorado," in the May-June, 1949, issue of THE EXPLOSIVES ENGINEER.

It may not be amiss to stress that the basis for the mine's accomplishments was a team of men who understood and applied fundamental research, plus laboratory and full-scale field experiments. Considerable credit for the success of the undertaking is attributed to E. D. Gardner, now chief engineer of the U. S. Bureau of Mines.

The barodynamic, theoretical, and experimental work was carried on in the School of Mines, Columbia University. Most of the rock testing was done by men of the U. S. Bureau of Mines. Messrs. Ertl, Wright, and Obert made valuable contributions to the efforts along these lines. At Rifle, the U. S. Bureau of Mines has demonstrated that tremendous advances in increasing the production rate per man-day in underground mining can be accomplished, and that production rates exceeding 200 tons per man-day are possible.



TECHNICAL STAFF: Left to right, H. J. Ballinger, mines superintendent; R. V. Carlson, master mechanic; F. D. Wright, assistant chief, Mining Section; E. M. Sipprelle, chief, Mining Section; E. E. Burgh, engineer in charge of research; F. L. Russell, engineer in charge of maintenance and surface facilities.

While the men at Rifle may be justifiably proud of their accomplishments, it is believed that they feel they are ushering in a new era in mining research with tremendous possibilities for serving not only the oil shale industry but the mining industry as a whole. It would be a mistake to conclude that mining research at Rifle has accomplished its objectives; it has merely given evidences of the possibilities of research in reducing mining costs and increasing safety. There should be no satisfaction with accomplishments until direct mining costs approach 10 cents a ton. The mining group has much to accomplish before it. The mining industry and the project should not allow a feeling of smugness to envelop them. The future may well indicate that one important contribution of the work at Rifle was to demonstrate the value of a full-scale unit mining-research plant for:

Verifying fundamental theory and laboratory research.

The carrying on of full-scale unit research in those fields not amenable to laboratory experiment.

The critical examination and support of new concepts by a group of able men of vision who

UNDERGROUND CREW: Standing, left to right, L. B. Cargile, scaler; W. G. Ramsey, compressor operator and maintenance; E. D. Robinson, blaster; C. D. Tucker, mine foreman; L. A. Wurtz, B. H. Algien, and H. H. Curtis, truck drivers. Kneeling, left to right, L. L. Brickey, blaster; C. W. Quinn and N. C. Payton, drillers; C. Merrel, scaler; J. A. Porter, shovel operator; W. H. Cutshall, bulldozer operator.

are sympathetic to new ideas and their development.

The development of young men of ability in and for the industry, imbued with the idea of research and the feeling that the way something is being done today is not quite good enough.

Accomplishments

An accompanying photograph shows the 13 men in the operating crew who, with present equipment, produce 1,500 tons of ore in eight hours. They comprise 1 foreman, 1 compressor operator and maintenance man, 2 drillers, 2 blasters, 1 shovel operator, 2 scalers, 1 bulldozer operator, and 3 truck drivers.

The demonstration illustrated the desirability of using men to control the behavior of mechanical units of large capacity, rather than as individuals performing foot pounds of work; also, the importance of proper planning and supervision.

Drill Jumbo

The multiple-drill jumbo, an important contribution to the success of the experiment, embodies unique and far-reaching ideas in design and drilling practice. Two men operate 4 drills and each averages 36 holes, 15 ft. deep, a shift, representing 540 lin. ft. of drill hole in a shift of 6½ working hours. When one compares this with the average of 50 ft. to 60 ft. a man-shift with standard equipment and procedures, the questions naturally arise as to how and why. Can this apparent miracle be accomplished in other mines? What effect will it have on percussion, rotary and long-hole drilling, and the mining methods in general use at present?

The multiple-drill jumbo, the multiple-drill benching machine, and the drilling procedures, with their innovations, are due mainly to the efforts of Messrs. Ertl, Ballinger, Burgh, McCrea, and the engineering personnel of Winter Weiss Company. They have made possible the increase in the drilling accomplishments per man-day, have put the miners on an engineering instead of an artistic basis, and have placed an engineer in charge of the rock-breaking process, with results as indicated. Each driller at the Rifle mine is given a drawing, with directions as to how to perform his work. The accomplishments of this group on drill steel, drill bits, and special drilling metals have contributed greatly not only to drilling technology but also to hopes for future refinements and progress.

Portable Compressor

The portable compressor and utility unit answers forcibly the continuing cry in most mines for more air. It makes better use of well-known thermodynamic principles for air compression and utilization, and does away with the difficulties attending long air lines. It is mainly the concept of Messrs. Ertl and Wright.

Blasting and Scaling Equipment

As one who trimmed roofs in Wisconsin zinc mines in the old days, and who spent considerable time and effort in constructing scaling ladders, the writer cannot help but appreciate the convenience and safety afforded by the devices at Rifle. Management will appreciate also the considerable decrease in roof-trimming costs as well as the increased safety which such mechanized units afford.

Underground Power Shovel

The blasted shale is loaded out by a 3-cu. yd. Bucyrus-Erie shovel into 15-ton Euclid Diesel trucks. All the other units serve the shovel which is the

focal point for a full-scale unit operation. At present, it is working in openings on the top bench, 27 ft. high by 60 ft. wide.

What will production rate of the shovel be when working in the lower benches, and when the rooms are made 100 ft. wide—as determined by barodynamic experiment—to permit a continuous movement of trucks instead of the procedure now being used?

Refining

The refining division at Rifle has set its sights on attaining mining costs of 60 cents a barrel, or 40 cents a ton, and retorting costs of 65 cents a barrel, or 43 cents a ton. That means it is expected to produce oil at $1.25 a barrel. Present indications are that these objectives will be attained.

The possibilities further envisioned in the refining program are a premium grade of Diesel fuel; a premium grade of jet fuel; a Fisher-Tropsch plant in conjunction with a retort to use the free gas; and enough free hydrogen to hydrogenate the oil. In addition, the combined mining and retorting of the oil shale offers possibilities of considerable magnitude.

It was my privilege to discuss new concepts in retorting, solid material flow, and utilization of both the retort products and its refuse. I was impressed with the fact that the men in charge of the project had vision, excellent training in the fundamentals, judgment, and experience. A detailed account of the chemical and refining division will prove to be of more than ordinary interest and value.

Project Personnel

The work at Rifle was started while Dr. R. R. Sayers was director of the U. S. Bureau of Mines. The present director, Dr. James Boyd, comes to his post with exceptional training and experience in the technical branches of the mineral sciences, an enviable war record, and proven ability as an administrator. In Dr. Boyd, the industry has a man who will encourage the spirit of research in the Bureau.

W. C. Schroeder, chief of the Office of Synthetic Liquid Fuels, is a chemical engineer by training. His work on boiler feed water at College Park and at New Brunswick is outstanding. In his present position, he has demonstrated an ability to attract men with outstanding abilities and personalities, and to get them to work together.

E. D. GARDNER
Chief mining engineer, U. S. Bureau of Mines

Boyd Guthrie, Oil-Shale Demonstration Plant chief, started with the oil-shale program in 1928. He was process engineer at the Rifle plant when it was closed in 1929. Between 1929 and 1944, he worked on petroleum and refining problems and was returned to Rifle in 1944. The plant in Colorado contains considerable of Guthrie and owes much to him.

Dan Lankford, chief assistant to Guthrie, is a Texan with chemical engineering training and background in petroleum refining. He has the broad technical vision necessary for his job.

E. D. Gardner, now chief mining engineer of the U. S. Bureau of Mines, and until recently chief of the Oil-Shale Mining Division, is a fortunate choice to head up the mining division. The Bureau's award to him of a citation and medal for outstanding services and contributions is an indication of the high esteem in which he is held.

BOYD GUTHRIE
Chief, Colorado Oil-Shale Demonstration Plant

Tell Ertl, a mining engineer, was Gardner's principal assistant until recently. He left the Bureau to become associated with an oil company in the development of an oil-shale program. Ertl contributed considerably in formulating plans for the project at Rifle and deserves much credit for the present success.

Emery M. Sipprelle, the present chief of the mining section, had an enviable war record and came direct from military service to the project. His record of accomplishment speaks for itself.

After field experience in mining, Fred D. Wright, assistant chief of the Mining Section, served with the engineers during the war. He was assigned to the Rifle project to carry on the barodynamic research work at Columbia. After completing the fundamental laboratory work, he came to Rifle and applied his knowledge successfully. His work in directing research and in developing new methods and equipment has borne fruitful results. It offers promise of further achievement in the near future.

Ernest M. Burgh, engineer in charge of mining research, came direct from school and war service to the project. He has developed in applied mine research particularly. His work on drill bits and drilling procedures has been a valuable contribution to the project.

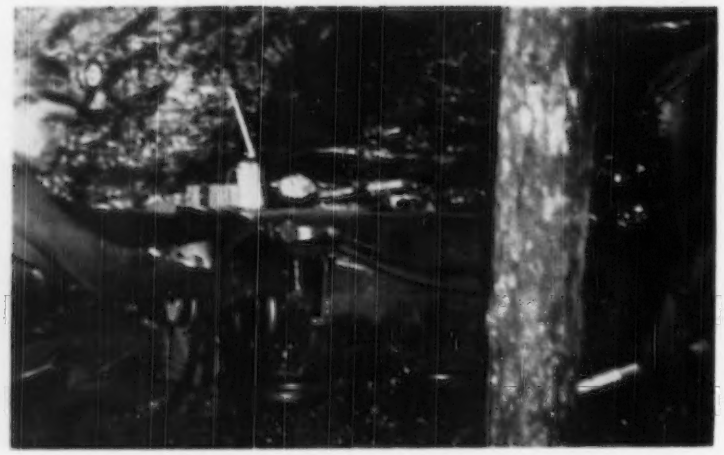
Homer J. Ballinger, mine superintendent, Raymond V. Carlson, master mechanic, and Paul L. Russell, engineer in charge of surface and maintenance facilities, are not only what their titles indicate, but also inventors, research men, and designers. Much of the credit for the innovations and the new designs in equipment introduced goes to these men.

And, finally, we have Dr. L. E. Young. Besides being president of the American Institute of Mining and Metallurgical Engineers, Dr. Young is a consulting engineer with a record of outstanding achievements. Because of his interest in mining research, as demonstrated by his faith in the project at Rifle, he has contributed much to the project beyond the call of duty.

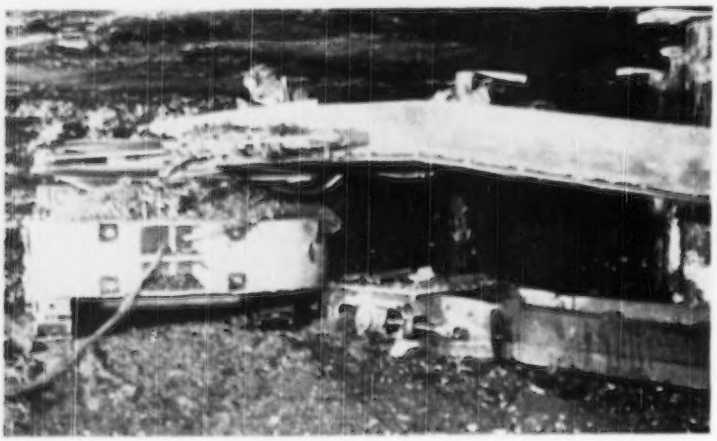
MINING ALABAMA COAL AT NEW CASTLE

A report on some of the operating procedures three miles underground.

JOHN A. FULMER*



UNDERCUTTING COAL: Four Jeffrey 35-B short-wall machines were employed in undercutting the coal seam, leaving a 6-in. kerf.



RECOVERING COAL: A Joy 8 BU loader recovering coal and loading it onto a conveyor in the center of a room in the mine.

In 1892, a mine was opened by Milner Coal, Iron & Railroad Company approximately 11 miles north of Birmingham, Alabama, on the main line of the Louisville & Nashville Railroad, to recover coal in the New Castle seam, on the east side of the Warrior Basin. The Milner Company was succeeded by Anniston Iron Corporation, and this company was succeeded, in due course, by McCormack & Ramsey, the present owners. In 1916, operations at the mine were taken over by New Castle Coal Company on lease. The latter company continued to operate the mine until July of last year. Since then the mine, known as No. 2 New Castle, has been inactive.

The first method of mining adopted at this location was the room-and pillar system, using a single entry and mule transportation. The coal seam pitched about 12 per cent west for approximately 1,400 ft., then continued through a rock fault for about 500 ft., on a 20-per cent grade to the basin.

In 1923, the New Castle Coal Company introduced electrification in the mine. From that time on, as modern equipment and improved methods became available, the property was operated on a more progressive basis. Production during the past ten years averaged 1,000 to 1,200 tons of coal a day.

Mining of the coal was carried on at working places about three miles underground, using two Joy 8 BU

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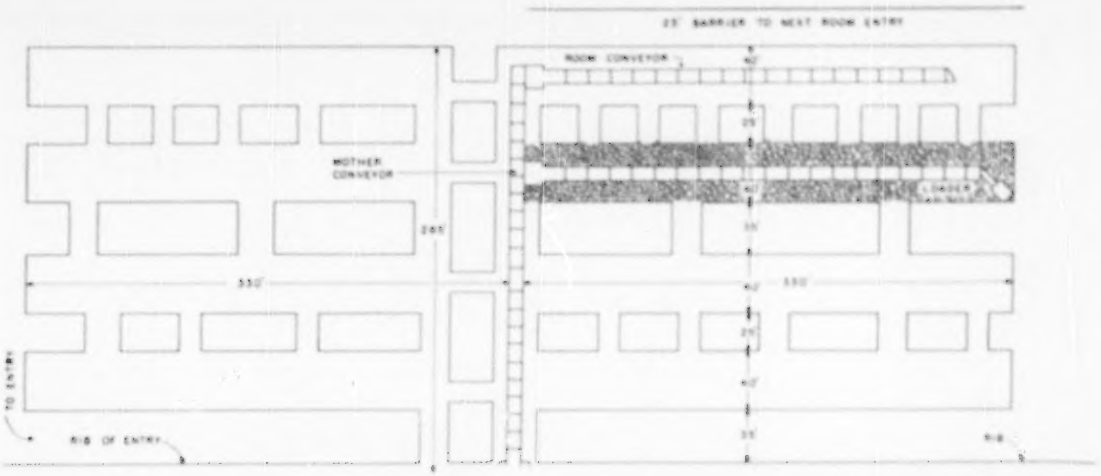


loaders on a panel system. The operations were about 80 per cent mechanical. The headings and narrow work were done by hand.

The New Castle seam is approximately 57 in. high, made up of about 22 in. of coal at the top, followed by 3 in. of rock, then 4 in. of coal, 6 in. of rock, and 22 in. of coal at the bottom. The roof is a combination of hard slate and sandstone; the footwall is rash and sandstone.

The New Castle Company mined the coal on an 8-room panel system, the panel being driven 285 ft. deep, with four rooms driven to the right and four rooms to the left. The rooms were 330 ft. deep and 40 ft. wide, with a 25-ft. pillar between each room in a pair, and a 35-ft. pillar between each pair of rooms, right and left. (See diagram.) A Joy loader loaded the coal onto a conveyor which was located in the center of each room. This conveyor moved the coal out of a room and discharged it onto a mother conveyor located in the main panel to the entry. The mother conveyor discharged the coal into mine cars for subsequent delivery to the surface.

The coal was undercut by four 35-B Jeffrey short-wall machines, each with a 7½-ft. cutter bar, which left a 6-in. kerf. Dust was kept to a minimum by the use of water on the cutter bar.

Drilling and Blasting

Using Chicago Pneumatic 571 DC coal drills and 1⅛-in. tungsten carbide bits, a working face was prepared for blasting by drilling eight bottom holes in the coal seams between the two bands of rock, and four

IN NARROW WORK: Mechanical equipment was used in 80 per cent of the operations in the mine. Only the headings and narrow work were done by hand.

AT THE CHAIN LANDING: An MH 100 Jeffrey mine locomotive delivering a trip of cars loaded with coal at the chain landing.

holes in the top coal seam close to the roof, each hole 6 ft. deep and 1¾ in. in diameter. When conditions required, extra holes were drilled where the rock was very heavy, and the number of holes was reduced where the rock was thin. The drill holes were loaded with Collier* C, usually with three to four cartridges in the bottom holes and two cartridges in the top and rib holes. The explosives were primed with electric blasting caps, with 8-ft. copper leg wires. When holes required a charge of three or more cartridges, the primed cartridge was usually placed second in the hole; when only two cartridges were necessary, the primed cartridge was placed first in the hole. The charge in each hole was stemmed with rock dust packed in 1¾-in. by 12-in. paper tamping bags, four bags to a hole. An average blast consisted of ten holes, connected in a straight series, fired by a conventional blasting machine. This blasting method provided a satisfactory breakage of coal and rock, easily handled by the Joy loading units. The results yielded approximately five tons of coal for each pound of explosives used.

HOMEWARD BOUND: At the end of a shift, the miners boarded the man trip for transportation out of the mine to the surface.

Mine Haulage and Ventilation

The coal was gathered from the mechanical loaders by two MH 100 Jeffrey mine locomotives. Coal from all narrow work was gathered by one MH Jeffrey and two 904 B Westinghouse mine locomotives. These locomotives gathered the loaded coal cars and delivered them to side tracks where they were picked up by two 906 C 8-ton main line Westinghouse locomotives and hauled about two miles to the foot of the slope incline. At this point they were picked up by rope haulage for delivery to the surface. The hoist that handled this haulage was a Hardie-Tynes first-motion unit with a 22-in. by 36-in. stroke, working at a steam pressure of 150 pounds developing 600 to 700 hp.

New Castle No. 2 mine was ventilated by a Sirrico 8-ft. double-inlet exhaust fan that delivered 75,000 cu. ft. of air a minute at 2.8 water gauge, using a split and continuous system.

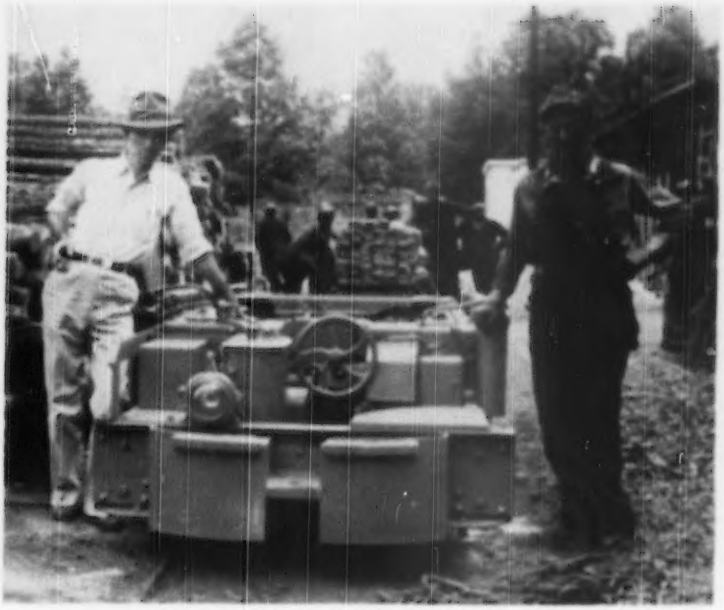
FOREMEN. From the left, H. C. Rogers, section foreman; Enoch Jacks, safety foreman; Cecil Eubanks, rock foreman; W. T. Bolden, section foreman; Fred Faucett, deadwork foreman; C. G. Jacks, mine foreman.

Processing

The tipple was double-tracked, one side for the landing of loaded cars, the other side to accommodate empties that were to be returned to the mine. After a trip was landed, it was picked up by a small hoist and pulled through a single-car rotary dump. As the cars were pulled through, the coal was dumped to the left and the rock was dumped to the right. The capacity of the surge bin was approximately 40 tons of coal.

From the surge bin the coal was delivered to a 36-in. belt conveyor that carried it to a vibrating screen where the 3-in. or larger sizes were bypassed to a Bradford breaker. The breaker reduced the larger sizes of coal and rock to 2⅜ in. The rock was

THE BOSS. C. D. Norris, superintendent and engineer at No. 2 New Castle mine.



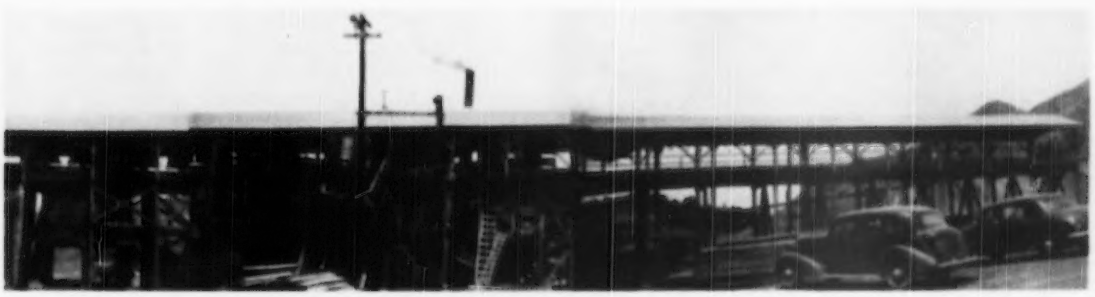
LEFT TO RIGHT. The author; a reconditioned locomotive; and T. J. Williams, chief mechanic and electrician inside the mine.

passed through the breaker to a 24-in. belt conveyor that discharged into a rock bin for disposal by a car to the refuse dump. The coal from the vibrating screen and the breaker was discharged onto a 24-in. belt conveyor and delivered to a Jeffrey elevating conveyor. The latter discharged into a washer bin, from where it was delivered to the washer for cleaning and screening by three Stewart 30-ton-an-hour jigs. After cleaning, the coal was delivered to a settling tank. The finished product was picked up by an elevating conveyor and delivered to a 600-ton bin for loading into railroad cars for shipment to the market. The refuse from the washer was discharged into a refuse bin by an elevator for delivery to the refuse dump.

Personnel

New Castle Coal Company's management and key personnel included Carr McCormack, president; Harold McDermott, vice president and general manager; C. D. Norris, superintendent and engineer; J. A. Fulmer, assistant superintendent and assistant engineer; and C. G. Jack and W. E. Handley, mine foremen.

The relationship between the management and the workers at No. 2 New Castle mine was generally conceded to be tops among the mines in the district. Most of the men who worked in the mine had been employed on and around the property all of their lives. It was not unusual to find a grandfather, father, son, and grandson working for the company at the same time. The labor turnover was so small that folks in the vicinity remarked that New Castle Coal Company didn't hire men—it reared them. The mining town of New Castle was an attractive community in which to live, the homes of the miners were well located and maintained, and the city of Birmingham was only 11 miles away.



THE TIPPLE. *During the past 10 years, production at No. 2 New Castle mine averaged 1,000 to 1,200 tons of coal a day.*

IN THE BEGINNING: An overall view of construction activities on the tailrace project, soon after the contractor had moved on the job.

A HYDROELECTRIC PROJECT IN NEW ENGLAND

The construction of a tailrace is the first unit let by contract in a $5,000,000 program of Holyoke Water Power Company.

E. F. PERREAULT*

THE construction of a tailrace in the Connecticut river marked the first operating phase in a $5,000,000 expansion program of Holyoke Water Power Company, Holyoke, Massachusetts, leading to the full development of the water facilities at the Holyoke dam. The program comprises an ultimate of four 15,000-kilowatt hydroelectric units.

A contract for the construction of the tailrace was awarded August 23, 1949, to D. D. O'Connell's Sons, Inc., Holyoke, Massachusetts, on a bid of $500,000.

The principal items in the contract specifications included the excavation of 90,000 cu. yds. of rock; 175,000 cu. yds. of earth; the construction of a tailrace 2,700 ft. long, ranging in depth—starting at the draft tube—from approximately 38 ft. and tapering down at its terminal end, to empty into the river bed. The section of the tailrace through rock is to be a side slope: two to one below the normal water level in the tailrace and one to one above the water level. The bottom width measures 55½ ft. and the top width is approximately 150 ft. In all cases the channel slopes are to be protected by a 3-ft. layer of riprap, underlined with a suitable layer of filter material where the natural soil is fine grained.

Subsurface investigations by Frank E. Fahlquist, a consulting geologist retained by Holyoke Water Power Company to examine the rock and overburden formations and to make recommendations, developed the following facts:

The rock is a thin-bedded, fine-tex-

*145 High Street,
Holyoke, Massachusetts.

tured, well-indurated sediment, known locally as Chicopee shale. The predominant color is gray, with variations to dark-gray, red-gray, and red. Some portions are strongly bedded with narrow, hard layers a fraction of an inch thick; others are less distinctly layered and of extremely fine grain. The overall fine texture and bedded character impart a strong cleavage, or fissility, to the rock. All the rock characteristics having to do with bedding, close folding, jointing, fracturing, crushing, and faulting are considered to have particular significance in excavating the rock. The formation is tilted in a southeasterly direction, the magnitude of inclination ranging from 10 degrees to about 90 degrees. In all core borings numerous evidences of fracturing and crushing were indicated.

Tailrace Specifications

The contract specifications set forth that the rock to be used for riprap must consist of graded material, 50 per cent to be sized from 1½ cu. ft. to 3 cu. ft. The material blasted on the job was to be used in the construction of the tailrace. It was estimated that sufficient rock would be available for the project requirements.

Coincident with the building of the tailrace, deep caissons were sunk to support the county bridge piers, the lateral aspects of which are in close proximity to the tailrace at that point. Because of the nearness of the tailrace excavation to the adjacent bridge piers and the shallowness of the bridge footings, it was necessary to guard against the collapse of the piers by a shear failure of the river bed material.

The county bridge was built in 1872 and reconstructed in 1888. It is supported on masonry piers resting on timber cribwork, extending to a depth of 4 or 5 ft. below the river bed. By constructing caissons around the piers the load was transferred to a lower level, to eliminate the possibility of failure of the bridge piers because of erosion or sliding. The method of underpinning involved drilling the bridge masonry with 6-in. diamond drills through the piers, 10 ft. in width, and inserting steel reinforcement rods through the drill holes and encasing the piers in concrete caissons.

Excavation in the tailrace was started about 700 ft. above the county highway bridge and proceeded toward the dam. Shale was encountered for a distance of approximately 1,000 ft. This necessitated drilling and blasting operations.

Seven UMW-40 Worthington wagon drills, equipped with 1⅝-in. Timken bits, were used to drill 12 to 18 holes approximately 15 ft. deep on 5-ft. centers. Three Worthington No. 500 portable compressors supplied air for the drills. The holes were loaded with 1⅝-in by 8-in. cartridges of semigelatin dynamite, primed with instantaneous

DRAGLINE AT WORK. Making a cut through the earth excavation with a Lorain moto-crane equipped with a dragline.

LEVELING OFF. A Caterpillar bulldozer busily engaged in scraping and leveling off the fill in the floor of the tailrace.

BEFORE A BLAST: The leg wires on the electric blasting cap primer in each charge are connected in a straight series.

LEFT TO RIGHT: Everett Burkhardt, construction engineer, Holyoke Water Power Company; and Daniel O'Connell, president, D. D. O'Connell's Sons, Inc.

and Short-Period Delay Electric Blasting Caps. The charges were stemmed with mud and sand. Blasts were fired with a conventional 50-hole blasting machine. An average of three blasts was fired during each eight-hour working day.

At first, the explosives-loading ratio was 2 lbs. of dynamite to each 1 cu. yd. of shale in the solid. Results proved that this explosives-loading factor was somewhat too high. Subsequent charges were reduced gradually until a minimum of ¾ lb. of explosives per cu. yd. was found to be satisfactory, especially in the production of a higher yield in riprap, which is an important item on this project.

Equipment

Water entering the river bed at the left of the project was channeled off into a small canal built close to the concrete flood wall, diverting the flow from the construction operations.

The equipment used to handle the earth excavation included three power shovels—a 2-cu. yd. Model 820 Lorain, a 1¾-cu. yd. Model 80 Lorain, a 2¼-cu. yd. Northwest—and a 1¾-cu. yd. Lorain truck crane Model 40. A 1¾-cu. yd. crane, equipped with a clamshell, was employed to remove blasted rock and load it into Euclid trucks.

For transporting the excavated material, the contractor used three 22-ton and three 15-ton Euclid rear-dump trucks, and five 11-cu. yd. Euclid bottom-dump trucks. The muck was used to extend the dike on the South Hadley Fall riverbank, to build cofferdams, to construct an access roadway, and for storage. Leveling and scraping operations were taken care of by four Caterpillar bulldozers and one TD-18 bulldozer.

During the early months, ideal weather conditions prevailed. By November 15, job operations were six weeks ahead of schedule, with two-thirds of the tailrace construction completed. The contract also called for the build-

AFTER A BLAST: The broken rock in the picture above is representative of the fragmentation obtained from primary blasts.

ing of an access roadway from the junction of the state highway, to parallel the flood wall on the Holyoke side to a point below the Holyoke dam. When the overall project has been completed, Holyoke Water Power Company plans to beautify the new roadway. It will be open to public use and will provide an ideal vantage point for the observation of the new facilities.

To remove seepage water from the cut and to dewater the pit in the event of flooding, one 8-in. and two 10-in. Worthington electric pumps were installed in the cut. Drilling operations on the bridge piers were done with the employment of 4 UMW Worthington wagon drills, with two Worthington No. 500 portable compressors supplying the necessary air. Cofferdams were built on both sides of the cut. Excavating operations continued for 1,000 ft. below the bridge structure, at which point the tailrace levels off with the river bed.

Personnel

Field offices were maintained on the riverbank adjacent to the rock cut of the channel, on the Holyoke side below the dam. The power company provided the necessary 220-volt, 3-phase, 60-cycle current from their own transformers. For the contractor, D. D. O'Connell's Sons, Inc., Robert A. Fischer is superintendent of construction; Charles Crowley, foreman of drilling and blasting; George O'Connell, supervisor of equipment; and Charles Salvi, foreman of steel workers.

Jackson & Moreland, Engineers, Boston, Massachusetts, were chiefly responsible for the design of the project for Holyoke Water Power Company. They were represented in the field by A. R. Gierasch. Holyoke Water Power Company was represented at the job site by Alston D. Mugnier, project engineer, and Everett Burkhardt, construction engineer.

As outlined at the beginning of this article, when the construction of the tailrace has been completed, contracts will be let by Holyoke Water Power Company for the building of a powerhouse at the Holyoke end of the dam. The first structure will house two 15,000-kilowatt generators—one will be installed upon completion of the structure, and the other generator when the necessity for additional electrical energy is indicated.

Contracts for the 15,000-kilowatt generator and the 14-ft. -diameter water wheel have been awarded to General Electric Company, Syracuse, New York, and S. Morgan Smith & Company of York, Pennsylvania. The wheel will be one of the largest installations of its kind in the East.

SHOVEL EXCAVATION. A 2½-cu. yd. Northwest unit removing broken stone from the river bed and loading onto a Euclid truck.

IN A ROCK CUT. Drill runners putting down vertical holes in Chicopee shale with wagon drills, for blasting through a rock cut.

COAL STRIPPING IN VIRGINIA AND WEST VIRGINIA

STRIPPING OVERBURDEN: An 820 Lorain power shovel at work, removing a bank of overburden covering the coal near Welch, West Virginia.

A brief account of the operations of Vecellio & Grogan, Inc.

R. H. COUNTS*

AFTER TEN ACTIVE YEARS in the construction of railroad and highway projects, the firm of Vecellio & Grogan, Inc., Beckley, West Virginia, moved into the field of strip-mining coal in August, 1947. Its first contract called for operations in the Cary seam in Buchanan County, Virginia, about 13 miles southeast of Grundy, on the Norfolk and Western Railway. The property is in high, mountainous country, at an elevation of 2,000 ft. above sea level, which made necessary the building of many miles of roadway to provide adequate haulage. To date, it has stripped about 6 miles of outcrop, representing the excavation of close to 2½ million cu. yds. of overburden and the recovery of 256,370 tons of salable coal.

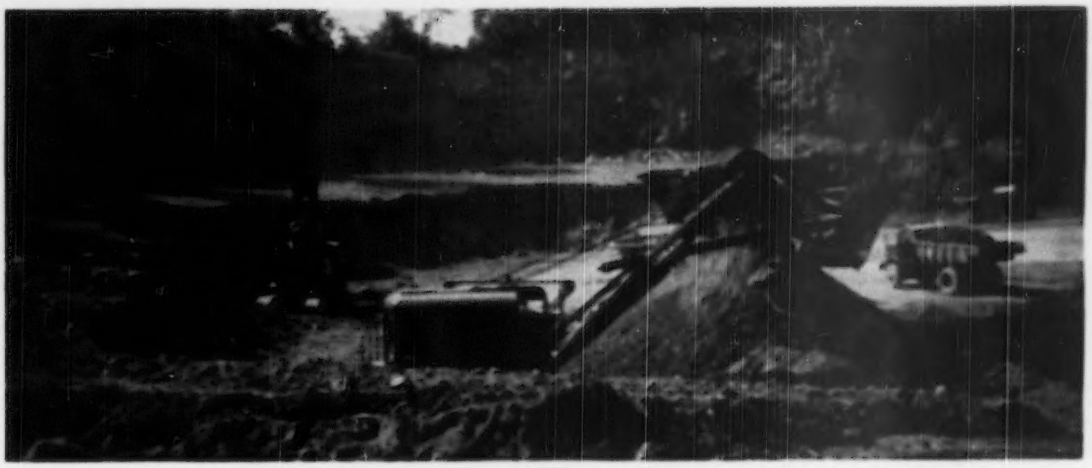
The coal seam at the Grundy stripping is 50 in. to 60 in. high. It is clean and free from partings or middleman, which minimizes cleaning operations at the pit. The coal is classified as a low volatile. It is an all-purpose product, useful for domestic and steam purposes and the lake trade. Working one 7½-hr. shift, production averages 600 tons of coal a day.

The overburden covering the coal, 40 ft. to 60 ft. high, is composed primarily of slate and shale. This makes it ideal for drilling horizontal holes for blasting. Primary blasts consist of 20 to 40 holes, drilled from 40 ft. to 60 ft. deep, on 12-ft. to 15-ft. centers. In most instances, the holes are located 2 ft. to 3 ft. above the coal. Occasionally some hard sandstone is encountered. When this occurs the holes are drilled close to the sandstone.

The drill holes are loaded with 4½-in. and 5⅛-in. by 24-in. cartridges of Hercomite† B and some ammonium nitrate types of dynamite. The explosives charges are primed with electric blasting caps. When ready to shoot, the leg wires of the caps are connected in series and blasts are fired with a 50-hole blasting machine. The results obtained are excellent, the ratio of cubic yards of overburden moved to pounds of explosives used is consistently high. Secondary blasting is practically negligible.

The principal equipment used includes a 2-cu. yd. Northwest, a 1½-cu.

*Special Representative,
Hercules Powder Company,
Charleston, West Virginia.
†Reg. U. S. Pat. Off.



CLEANING UP: On the last leg of the Welch stripping contract—5,000 tons remain to be loaded and the job will be completed.

yd. Northwest, and a ¾-cu. yd. Lorain power shovels; five D8 Caterpillar dozers; two Tournapulls; three 12-cu. yd. Euclid rear-end dump trucks; two D7 Caterpillar tractors with 14-cu. yd. Athey wagons; a No. 12 Caterpillar motor control grader; a Hough pay loader; a 6-in. horizontal drill; a vertical coal drill; a Gardner-Denver air compressor; a truck with electric welder; and a mechanics' truck equipped for any emergency repairs on the job. LeTourneau and Euclid trailers are employed to haul the coal about 1½ miles to a specially built bin, where it is dumped and loaded into the company mine cars and transported by locomotives to the tipple. At the tipple the coal is thoroughly cleaned and graded to meet the rigid specifications

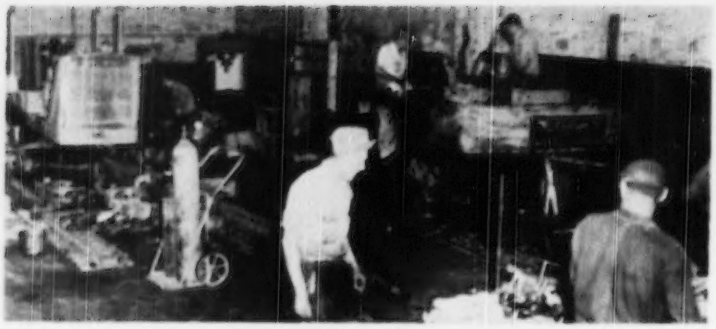
LOADING OUT: Another view of the shovel excavating and loading overburden into a 12-cu. yd. Euclid truck for disposal on the job.

of the coal company. J. F. Scites is superintendent on the job near Grundy, Virginia.

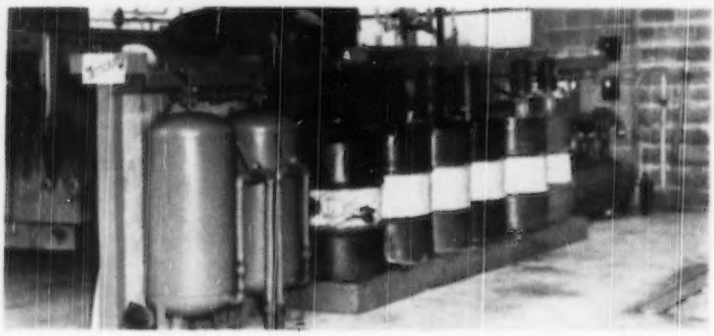
In October, 1947, Vecellio & Grogan took its second contract to strip and recover coal at a location near Welch, McDowell County, West Virginia. The general conditions encountered at this strip mine are similar to the operations near Grundy. The height of the

COMPANY MANAGEMENT: Left to right: Enrico Vecellio, president; Leo Vecellio, vice president and general manager; E. G. Grogan, secretary and treasurer.

R. L. GROGAN: Superintendent at the Welch project.



MACHINE SHOP: About 96 per cent of major equipment repairs is taken care of in this shop, equipped with modern, diversified mechanical units.



UP TO DATE: This combination wash and grease room made possible a reduction in mechanical repairs and minimized equipment breakdowns.

coal seam averages 32 in. to 48 in. Up to the present, the contractor has stripped about 5 miles of outcrop, involving the excavation of approximately 1½ million cu. yds. of overburden and the production of 140,000 tons of coal.

The principal equipment on the Welch job includes two power shovels, a 2-cu. yd. Lorain and a ¾-cu. yd. Northwest; three D8 and two D7 Caterpillar dozers; three 12-cu. yd. Euclid rear-end dump trucks; a No. 12 Caterpillar motor patrol grader; a 6-in. horizontal drill and a vertical coal drill; and a mechanics' truck equipped to handle emergency repairs.

The coal is hauled by autotrucks from the strip mine to a bin and dumped into coal company mine cars for transportation through a mountain 3,000 ft. long to the tipple. After processing through the tipple, the coal is loaded into railroad cars for shipment to various customers. Roy Grogan is superintendent on the job near Welch, West Virginia. Ray Spade was awarded the contract for the truck hauling of coal at this operation, using GMC and Ford trucks.

The contractor's main repair shop is located in Beckley, West Virginia, about 85 miles from its strip-mining operations. The shop is equipped with lathes, drill presses, a 5-ton traveling crane, a 100-ton hydraulic press, valve refacers and reseters, grinders, air compressors, electric and acetylene welding outfits, tire repair facilities, and a blacksmith shop. Most of the major repair and overhaul jobs of equipment are taken care of in the company shop. Units requiring repair are hauled to the shop by the contractor's trailer equipment. Emergency repairs are taken care of by a field repair shop and mobile equipment, maintained on the job.

Vecellio & Grogan, Inc., organized in 1939, is a member of the American Road Builders Association, Associated General Contractors of America, and West Virginia Highway Contractors Association. The officers of the company are Enrico Vecellio, president; Leo Vecellio, vice president and general manager; E. G. Grogan, secretary and treasurer; and Mrs. Erma Grogan, assistant secretary and treasurer. Vice President Leo Vecellio was elected recently to the presidency of the West Virginia Contractors Association.

(Since this article was written, E. G. Grogan, secretary and treasurer, died and was buried at his birthplace, Martinsville, Virginia.—Editor.)

HEADQUARTERS: From left to right, Vecellio & Grogan's machine shop, supply room, wash and grease room, and office.

NEWS NOTES

GARDNER-DENVER SINKER DRILL

A new 45-lb. class sinker of advanced design has been announced by Gardner-Denver Company, Quincy, Illinois. Known as the S48, this new sinker is said to have superior drilling, rotating and hole-cleaning characteristics that make it especially suitable for use with modern tungsten carbide rock bits. Performance tests show that the S48 Sinker equals most 55-lb. drills in drilling speed and rotative power, according to reports from the manufacturer.

Designed for either wet or dry drilling, the S48 can be changed from wet to dry or to automatic air-operated water control merely by changing the easily removed gland and tube. The conversion is made without taking the drill apart, and without changing the backhead.

Further information can be obtained by writing direct to Gardner-Denver Company, at Quincy, Illinois.

WYCO VIBRATOR CATALOG

Wyzenbeek & Staff, Inc., 841 W. Hubbard Street, Chicago, Illinois, announces the new 50V WYCO Concrete Vibrator Catalog.

Many improvements are shown, such as replaceable rubber tips for vibrator heads, which are optional and interchangeable. The catalog contains complete information on both vibrator and contractors grinders.

Copies may be obtained by writing to Wyzenbeek & Staff, Inc.

THE G-150 LIGHT WAGON DRILL

The new G-150 Lightweight Wagon Mounting, recently developed by the Chicago Pneumatic Tool Co. for handling sinker drills of the 55-lb. class, or 3-in. drifters, is now available.

Designed for increased footage, in one-man operation, the G-150 features:

1. Longer steel changes—6 ft. materially increases actual throttle time.

2. No *operator fatigue*—newly developed feed motor does the work.

3. Powered steel puller eliminates wrenching of steel and loss of holes in bad drilling ground.

4. Positive and uniform feeding pressure *promotes faster* and drilling speed with *lower* air consumption per foot drilled.

5. Universal-type saddle, adjustable laterally on the crossbar, assures quick positioning for drilling *at any angle*. A sliding cone allows adjustment for uneven ground conditions.

6. Ball bearing wheels with pneumatic tires make moving easy.

Because it eliminates operator fatigue, this mounting greatly increases footage per shift as compared to hand-held drills.

For further information request Bulletin SP-3010, Chicago Pneumatic Tool Company, 6 East 44th Street, New York 17, New York.

SCHOLARSHIPS

Several Henry Krumb scholarships are awarded annually to students who are candidates for the B.S., E.M., or M.S. degrees in Mining, Metallurgy and Mineral Engineering from Columbia. The value of each scholarship is $1,000 together with the cost of transportation from the student's home to New York City.

Scholarships may be awarded to Students qualifying for admission to Columbia College and registering for School of Mines undergraduate study; Students from other institutions who are accepted for admission by the School of Mines and desire to pursue work for the B.S., E.M., or M.S. degrees.

Applications accompanied by certified transcripts of academic records, and supporting letters of recommendation, should be filed with the Admissions Office of the University before March 15, 1950. Application blanks and announcements will be forwarded to interested persons by the Admissions Office of the University on request. For further information write to P. B. Bucky, Executive Officer, School of Mines, Columbia University, New York 27, New York.

GLASS HAT BY BULLARD

After more than a year of development work and testing, E. D. Bullard Company, 275 Eighth Street, San Francisco 3, California has announced a new crown for the famous Hard Boiled Hat. The material is resin-impregnated Fiberglas that under test is claimed to be the strongest, most resilient crown ever built for a safety hat. According to the manufacturer, this crown is impervious to moisture and acids, it passes all dielectric tests; the crown is nonshattering and nondeteriorating with age.

The manufacturer is able to produce the hat in practically any color desired. Standard colors are white and grey, others available in quantity orders. Colors are permanent; the pigment is impregnated all through the material. This feature is of special interest to safety men in plants where work conditions require color for visibility. Colors may be used for identification of crews on large-scale operations including a pigmented hat that glows in the dark, for tunnel or mine workers, night construction crews, and others.

Full information on the new Hard Boiled Hat is available from E. D. Bullard Company.

NEW GAS-FUME RESPIRATOR

The new M.S.A. Gas-Fume Respirator for protection against mists, dusts, fumes, organic vapors, and acid gases which occur in burning, spraying, pouring, welding, cutting, and other industrial operations is fully described in an illustrated bulletin now available from Mine Safety Appliances Company.

Designed to combine protection with working comfort, the M.S.A. Gas-Fume Respirator employs twin replaceable filters which are mounted on the wearer's back. Back-mounting permits unobstructed vision and working freedom. Other comfort and safety features are the "Comfo" face-seal facepiece, guarded exhalation valve, and inhalation check valve. The entire unit weighs only 2 lbs. 14 oz.

For a complete description of the features and uses of this multi-purpose respirator, write direct to Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh 8, Pennsylvania.

SOUND-POWERED TELEPHONES

The United States Instrument Corporation of Summit, New Jersey, announces its new line of Sound-Powered Telephones for industrial and mine use in a new catalog recently released.

These stations, which operate without batteries or any outside power for either talking or ringing circuits, have been completely redesigned inside and out.

Each station consists of a Sound-Powered Telephone Handset mounted on the aluminum case which contains a 1200-cycle magneto generator, a howler unit with connecting horn for signaling, the necessary terminal blocks and, if selective ringing is desired, a rotary selector switch.

FOR FUTURE REFERENCE . . .

THE EXPLOSIVES ENGINEER

The six issues of The Explosives Engineer published in 1949, which comprise Volume 27, are available, bound attractively in cloth. These will be sent to any post-office address in the United States and Canada for $3.50 each, or for $4.25 to post-office addresses in other countries.

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The McCarthy Vertical Drill, manufactured by The Salem Tool Co., is adaptable to high wall and key way drilling and diamond drill boring . . . drills 90% of all limestone and sand rock formations, and readily burrows through shale. Send today for complete information, and for a free copy of The Salem Tool Company booklet.

MINING EQUIPMENT SINCE 1901

SALEM

THE SALEM TOOL COMPANY

SALEM, OHIO, U. S. A.

Nutt Bailey Bauxite Mine

(Continued from page 11)

face, an amount which will not keep a mucking machine busy for long. This difficulty will eliminate itself when caving is commenced.

The third difficulty is the lack of a satisfactory trailer design. The stresses on the types which have been made so far have caused many breakdowns. This problem is being worked on and it is expected that a satisfactory trailer will be devised. The jeep frame and springs were not constructed for this type of work and it has been necessary to reinforce the frame and install heavier springs. Otherwise, their operation is highly satisfactory.

If the procedure outlined continues to work successfully, it will be adapted to a new mine which the Dulin Bauxite Company has begun to develop in Saline County, Arkansas. The mine will be the deepest one in the district. The ore body, containing over a million tons of ore, lies at a depth of 400 ft. to 500 ft. and is spread over 60 acres. The deposit will be reached by a drilled shaft, the deepest ever attempted by the Layne Arkansas Company. These drilled shafts are necessary because of the overburden of clay and sand that has to be penetrated.

The sinking of such a shaft is unique and expensive. Because of the extreme fluidity of the sand that has to be penetrated, a steel-lined shaft is a strict necessity. A recent happening at the Nutt Bailey mine where a driller was drilling a 6-in. hole for ventilation is reviewed to illustrate this fact. The hole had been spotted in a pillar so that it could be cased and concreted before being connected to the mine. Somewhere during the drilling, a rock was encountered and the drill deflected. Instead of hitting a pillar, the bit broke into a drift and a hole estimated to be 4 in. in diameter was opened. The operator, seeing the mud beginning to drop, commenced to pull his string of tools. Within two minutes, the same operator felt the ground giving way beneath him and he was forced to run from the rig. Within five minutes a 20-ft. hole appeared on the surface, and the drill truck was in the big middle of it. The truck had to be cut loose from the drill stem, and it required the services of a bulldozer, a shovel, and the biggest wrecker in Arkansas to recover the truck.

In Conclusion

Current plans for sinking the shaft call for the drilling of a 12-in. pilot hole. This will be reamed to 20 in., the walls being held in place by a heavy mud. Following this, the hole will be reamed to 85 in. to a depth of 200 ft. and cased with 86-in casing. When this casing is in place, a plate will be welded on the top with pipe through its center to the 200-ft. level. The mud will remain inside the casing. Pressure will be applied at the top and concrete will be pumped through the pipe until it rises to the surface on the outside of the casing. With this 200 ft. of casing in place, the pilot hole will then be reamed the remaining 200 ft. to 74 in., and cased with a 74-in. casing. The cementing operation will be repeated. When the second casing is in place and set, the two casings will be welded together to form one unit. The cost of this operation is estimated at $186 a ft., and it will require approximately six months for completion.

When the shaft is completed, two inclines will be driven from it through the ore body to the opposite extremity. Parallel stopes will then be riven off the incline along the bottom contours and the mine thus developed. To provide ventilation along the main incline, 12-in. holes will be driven at 300-ft. intervals. It is contemplated that this mine will be laid out and operated so as to allow full control of ventilation.

No explanation is offered herein as to why a jeep will operate in apparent safety and fail to produce concentrations of the highly toxic carbon monoxide. Dilution may be a factor since there are some 2,300,000 cu. ft. in the mine. But, when it is considered that this capacity is not contained in several large rooms but rather in a multitude of 8-ft. by 10-ft. openings, this hardly seems to be a feasible answer. It may be that bauxite has a hitherto unknown affinity for carbon monoxide and automatically removes it from the air. If so, there are endless possibilities to which it could be put. This operation will bear watching by the entire bauxite-mining industry—if it continues to work successfully, it will provide one answer to the ever-present question of how to cut costs.

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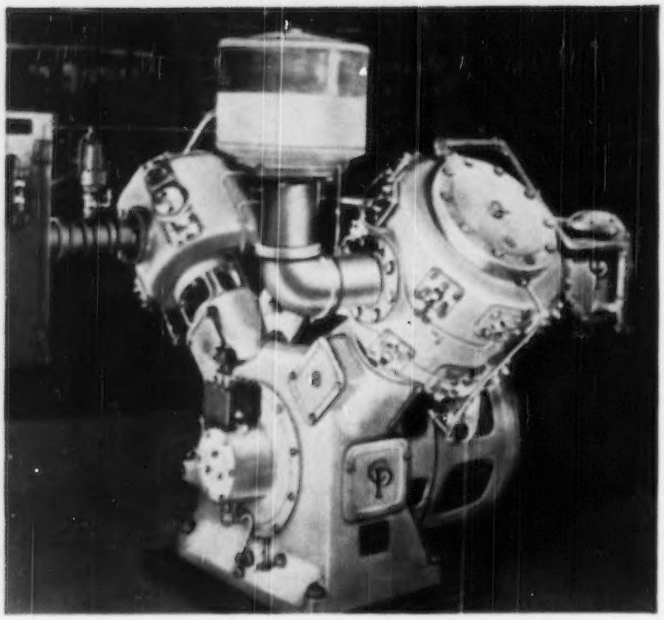

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It operates at high efficiency because of such valuable features as large area Simplate valves, multi-step capacity regulation, effective inter-cooling, precision bearings and force-feed lubrication.

And finally it's extremely easy on maintenance.

Available with built-in or direct-coupled motor, or with V-belt drive, in capacities of 500 to 900 c.f.m., at 80 to 125 pounds pressure. Sizes for other pressures also furnished.

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Primacord does this with a combination of forces that team up to give you more complete fragmentation. Down-hole lines initiate the whole charge instantly, from top to bottom, with all the power of primer cartridges. Main lines can be laid out so that front holes go a split second before succeeding ones, allowing for planned relief of burden.

You can get Primacord, wound on easy-to-handle spools, in a grade to meet every blasting condition. It's insensitive to stray currents, and hooks up as fast as you can tie square knots or half hitches. Ask your supplier about Primacord, or write direct to The Ensign-Bickford Company, Simsbury, Connecticut.

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GREATER EXPLOSIVE CAPACITY — A 9" hole, for example, holds 125% more explosive than a 6" hole. Holes may thus be more widely spaced, necessitating fewer holes. Greater mass of explosive produces better fragmentation, less need for secondary blasting.

COMBATS SPRUNG HOLES — Large diameter hole takes a greater powder charge at bottom of hole, assures pulling the toe of the bank.

INCREASED TONNAGE — Wide spacing and greater powder charge increase breakage. One mine needed 2 or 3 crews working wagon and tripod drills to prepare 1000 tons of ore per day. Now a Bucyrus-Erie-equipped crew prepares 600 tons per hour.

EXPLOSIVE AND DRILLING COST NOT CHANGED — Ratio of explosive to rock prepared remains constant no matter what size hole is used. In most cases, the cost per foot of drilling large-diameter holes is equal to or less than the cost per foot of drilling small holes.

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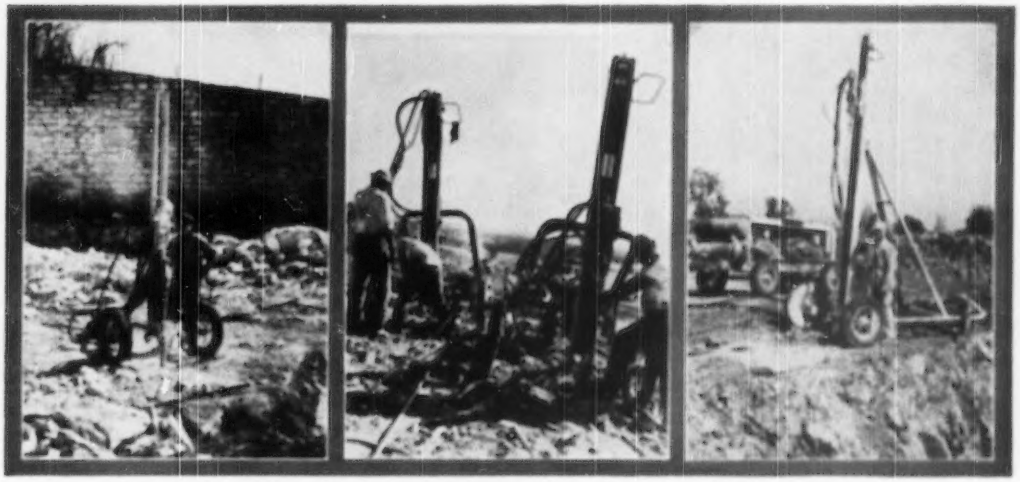
Do your jobs call for fast drilling? Big footage on every shift? Then you'll want the universal URM—for the last word in wagon drill efficiency and performance.

type three

Do you run into a lot of heavy rock excavation — with cuts up to 40 feet deep? Then the Gardner-Denver WD is the wagon drill for you. It's specially designed for deeper holes.



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